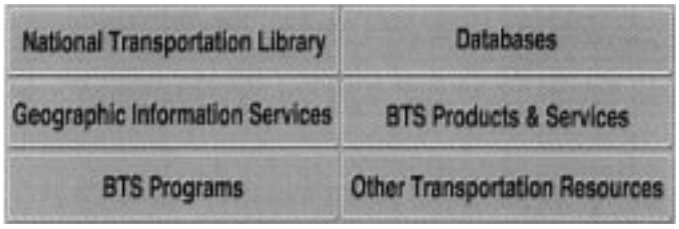
# The State of Transportation Statistics




Congress created the Bureau of Transportation Statistics (BTS) to establish a policy-relevant knowledge base for decisionmakers, and to inform the public about transportation and its consequences. Toward these ends, Congress called for BTS to assess both the state of the transportation system and the state of transportation statistics in the *Transportation Statistics Annual Report* (TSAR). Specifically, the annual report is to include "documentation of the methods used to obtain and ensure the quality of the statistics presented in the report, and recommendations for improving transportation statistical information."

This chapter builds on previous TSAR assessments of transportation statistics. TSAR 1994 highlighted information needs expressed in congressional mandates, reports of the National Academy of Sciences, and customer responses to initial BTS products. TSAR 1995 outlined a comprehensive strategy of data collection and analysis for meeting the initial set of needs. In 1996, BTS articulated a more detailed list of information needs and described the progress made toward meeting those needs.

This 1997 assessment comes at a good time to step back, review the path followed by BTS and other information-producing agencies, and examine whether that path remains appropriate to follow into the 21st century. The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), under which BTS was created, authorized federal spending on highways, transit, and statistics through fiscal year

Table 5-1.

**A Brief History of Transportation Statistics**

**1808** The first national transportation policy study is produced by Secretary of the Treasury Albert Gallatin.

**1861** Six decades of geographic data collection by the federal government are summarized in *Reports of Explorations and Surveys To Ascertain the Most Practicable and Economical Route for a Railroad from the Mississippi River to the Pacific Ocean,* prepared by the Secretary of War for the U.S. Senate.

**1887** The Interstate Commerce Commission is established, initiating the collection of data from carriers to support regulation.

**1920–1921** The U.S. Army Corps of Engineers begins publishing data on water transportation commerce and ports.

**1934** The Federal-Aid Highway Act authorizes funds to be spent by state highway departments on surveys and economic analyses.

**1944–1970** The largest metropolitan areas conduct large-scale studies of urban travel and transportation capacity.

**1945** The Bureau of Public Roads (predecessor to the Federal Highway Administration) publishes the first *Highway Statistics.*

**1957–1963** The Census Bureau initiates the Census of Transportation, including surveys of trucks, unregulated motor carriers, commodity movements, and long-distance passenger travel.

**1958** The Federal Aviation Administration Act establishes the current mandate for collection of airline financial and operating statistics.

**1960** The Census Bureau begins to collect journey-to-work data as part of the Decennial Census of Population and Housing.

**1962** The Federal-Aid Highway Act establishes a data-rich comprehensive planning process for metropolitan areas.

**1966** The Department of Transportation (DOT) Act creates DOT and requires the Secretary of Transportation to "promote and undertake the development, collection, and dissemination of technological, statistical, economic, and other information relevant to domestic and international transportation."

**1968** The Federal Highway Administration begins publishing a biennial highway needs report.

**1969** The Federal Highway Administration initiates the first Nationwide Personal Transportation Survey. DOT summarizes the state of statistics in *Transportation Information: A Report to the Committee on Appropriations, U.S. House of Representatives, from the Secretary of Transportation* (the Red Book).

**1970–1971** DOT publishes the first edition of *National Transportation Statistics*. Passage of the National Environmental Policy Act and Clean Air Act highlight the need for environmental data related to transportation. The Census Bureau significantly expands the content and geographic detail of journey-to-work data collected under the Decennial Census of Population and Housing.

**1972–1974** DOT publishes two *National Transportation Reports* in which data are compiled on all modes.

**1974** The National Urban Mass Transportation Assistance Act mandates collection of data on the transit industry. Energy data becomes a major concern with the first oil embargo.

**1975** The Fatal Accident Reporting System is initiated by the National Highway Traffic Safety Administration. The Census Bureau conducts a survey of domestic transportation of foreign trade.

**1976–1986** DOT annual spending on multimodal transportation data shrinks from approximately $4.5 million to less than $0.5 million (in 1982 dollars).

**1977** A national transportation atlas and the last DOT *National Transportation Report* is published under the title *Trends and Choices.* The Census Bureau conducts the last quinquennial Commodity Transportation Survey and National Travel Survey.

**1978–1980** Airlines, railroads, and motor carriers undergo significant economic deregulation, and most data-collection programs by regulatory agencies are subsequently reduced or terminated.

Table 5-1.
**A Brief History of Transportation Statistics *(continued)***

**1979** The National Transportation Policy Study Commission calls for a continuing commitment to the development of transportation statistics in the last comprehensive assessment of transportation published by a federal agency until 1990.

**1982** The Census Bureau terminates the quinquennial collection of data on commodity flows and passenger travel due to funding and methodological problems.

**1990** DOT publishes *Moving America: New Directions, New Opportunities—A Statement of National Transportation Policy Strategies for Action,* which calls for a renewed commitment to transportation statistics.

**1991** The Transportation Research Board completes its recommendations in its report, *Data for Decisions: Requirements for National Transportation Policy Making.* The Intermodal Surface Transportation Efficiency Act (ISTEA) is passed mandating the establishment of the Bureau of Transportation Statistics (BTS).

**1992** The Federal Highway Administration begins work with the Census Bureau on the Commodity Flow Survey. The DOT management order implementing the ISTEA mandate for BTS is signed in December, and management of the Commodity Flow Survey is transferred to BTS.

**1993–1995** BTS and the Census Bureau conduct the Commodity Flow Survey, the American Travel Survey, and the Transborder Surface Freight Transportation program. BTS publishes its first *Transportation Statistics Annual Report.* BTS receives the surviving data functions of the Civil Aeronautics Board from the Research and Special Programs Administration.

**1996** BTS receives the motor carrier financial and operating statistics program from the Interstate Commerce Commission.

1997. ISTEA reauthorization will set the course for these programs in the years ahead. At this juncture, it is important to establish whether the information needs reflected in the ISTEA have been met, and, if there are new needs emerging, how they will be addressed. This chapter highlights BTS's progress, how the world of information may change, and what future directions decisionmakers might consider for transportation statistics programs.

## How Far Have We Come?

When the ISTEA was enacted, transportation statistics had passed through two strikingly different eras (see table 5-1). A long period of increasing interest in transportation statistics reached its zenith in 1977 with major data-collection activities in all modes of transportation, the publication of comprehensive analyses of national transportation needs and a national transportation atlas, and a joint program of multimodal data collection by the Department of Transportation (DOT) and the Census Bureau of the Department of Commerce. After 1977, transportation statistics entered a period of decline as deregulation and shrinking budgets brought many federal programs to an end. No comprehensive national analyses of transportation were conducted by the federal government between 1979 and 1989. No national multimodal data on commodity flows were collected between 1977 and 1993. Although the supply of transportation data declined, the demand for this information remained strong.

Reports issued at the beginning and end of these two eras in transportation statistics emphasized the need to maintain information on commodity and passenger flows to understand transportation system performance. Two assessments, in particular, helped to shape subsequent ISTEA mandates related to data. The first assess-

ment, *Transportation Information: A Report to the Committee on Appropriations, U.S. House of Representatives, from the Secretary of Transportation*, was published in 1969; the second assessment, *Data for Decisions: Requirements for National Transportation Policy Making*, was published by the Transportation Research Board of the National Academy of Sciences in 1991. Both emphasized the importance of developing new technology for data collection to improve accuracy and reduce respondent burden. The 1991 assessment added the need for a National Transportation Performance Monitoring System, anticipating the Government Performance and Results Act (GPRA) and a blossoming interest in performance measurement by all levels of government. As indicated in table 5-2, the ISTEA responded to the ongoing needs for information articulated in both assessments and set a course that BTS continues to follow.

Many ISTEA sections relevant to BTS can be characterized as a mandate to recapture past capabilities and understanding, demonstrating that the establishment of a knowledge base for transportation requires continuous investment. The Intermodal Transportation Database called for in Section 5002 of the ISTEA is largely fulfilled by the Commodity Flow Survey and the American Travel Survey, both of which are direct descendants of the 1977 Census of Transportation. The requirements in Section 6006 of the ISTEA for a *Transportation Statistics Annual Report* reestablish many aspects of the old *National Transportation Report* (although the latter report went beyond the state of the transportation system to include policy recommendations and estimates of investment needs). The ISTEA emphasis on data dissemination reinforces a similar mandate in the Department of Transportation Act of 1966, and the ISTEA focus on the promulgation of internal guidelines and external coordination requires BTS to do what the former Office of Information Policy attempted within the Office of the Secretary of Transportation in the 1970s.

BTS has made significant progress in most areas specified in the ISTEA. Specifically, BTS has:

- published four comprehensive TSARs, and continued to annually compile and publish *National Transportation Statistics* (NTS);
- completed surveys of commodity and passenger flows by all modes and intermodal combinations;
- initiated joint efforts with Canada and Mexico to create a continental view of transportation in North America;
- established the Standard Classification of Transportable Goods and participated in other statistical standard-setting activities;
- become a leader in developing geographic databases and geographic information systems (GIS) technology; and
- established an aggressive data dissemination program through CD-ROMs and an award-winning Internet site.

Box 5-1 shows the breadth of BTS accomplishments in responding to ISTEA mandates over the course of the four years between the start of operations and January 1, 1997.

## Information Needs and Resources Beyond ISTEA

The ISTEA fueled major initiatives to meet the longstanding demand for data by the transportation community, but some needs identified in *Data for Decisions* remain to be filled. In addition, new data demands are arising from the rapidly evolving worlds of information technology and transportation.

## Ongoing Demands for Information

Most needs for basic transportation statistics persist over time. For example, information about the quantity and distribution of travel, commodity movements, and vehicle activity has been relevant for decisionmaking throughout the history of U.S. transportation policy. Timely, reliable data to meet decisionmakers' needs are always important.

*Domestic transportation of international trade.* This information is increasingly critical given the dramatic growth in international freight movements, the increasing dependence of domestic businesses on global markets, and competition among transportation service providers throughout North America as U.S. borders with Canada and Mexico become less restrictive for goods movement. In the mid-1970s, the Census Bureau conducted surveys to confirm or complete key information on a sample of import and export documents. This information included the inland destination of imports and origin of exports, the means of transportation between the inland locations and the port or border crossing, and the weight of the shipment. Although the 1993 Commodity Flow Survey (CFS) captured much information about exports, it only surveyed what domestic establishments shipped, and thus did not capture imports. The Transborder Surface Freight Transportation Data Program only covers truck, rail, and pipeline movements, and like other foreign trade data, is limited to identifying inland geography.

*Time and reliability statistics.* From the perspective of travelers and shippers, time and reliability are as basic as cost for measuring the performance of transportation. Customer-oriented service providers and investors share this concern. National information on scheduled travel time and on-time performance is limited to major air carriers and Amtrak. Journey-to-work travel times are also reported in the Decennial Census of Population and Housing. Only anecdotal information exists on travel time and reliability of other passenger trips, which account for the majority of travel, or about freight transportation.

*Costs of transportation.* Cost data are essential to understanding transportation's performance, measuring productivity, estimating the impacts of public policies and private sector actions, and forecasting future trends and reactions to policies and programs. Before economic deregulation, carrier filings provided cost data specific to individual services and segments of the transportation network. These data have largely disappeared, reflecting the loss of reporting requirements after deregulation, extensive replacement of published tariffs by contract rates, and market innovations, which blur traditional cost accounting. The most detailed remaining information is for commercial aviation.

*Motor vehicles.* The numbers of motor vehicles and how they are used are a key concern when looking at their relationship to congestion, highway cost allocation, energy consumption, environmental pollution, and exposure to safety risks. While reliable inventory and use statistics for all classes of vehicles are not yet available, some progress can be seen. For example, major improvements have been made in the Truck Inventory and Use Survey, and alternatives for improving the quality of data provided by the states to the Federal Highway Administration are being assessed. Such promising data sources as the International Fuel Tax Agreement and the International Registration Plan remain to be mined, however.

*Railroad geography and condition.* Because most railroads are private companies, publicly available information on location and connectivity lacks adequate details, and is largely nonexistent on capacity and condition. Better information is needed to assess mergers, aban-

Table 5-2.

**The Demands for Statistical Programs and the ISTEA Response**

| **U.S. Department of Transportation (DOT), *Transportation Information: A Report to the Committee on Appropriations, U.S. House of Representatives, from the Secretary of Transportation*, May 1969** | **Transportation Research Board, *Data for Decisions: Requirements for National Transportation Policy Making*, Special Report 234, National Research Council, 1991** | **Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA)** |
|---|---|---|
| NA | Establish a Transportation Data Center within the Department of Transportation. | Established the Bureau of Transportation Statistics (BTS). |
| National survey of total tripmaking by household characteristics; surveys of air travelers to learn trip purpose, airport access, mode choice variables, and general aviation use; resurrect the Interstate Commerce Comission's rail waybill origin-destination data-collection program and expand to rail shippers; data-collection program for regulated and nonregulated truck origin-destination patterns; air cargo waybill survey. | Collect passenger and freight flow data to provide basic system information on origin-destination, who or what is moving, and by what mode. | Called on BTS to establish an intermodal transportation database, including commodity and passenger flows, and public and private investment in facilities and services. |
| Link-specific data on highway and rail network facilities, including location, speed, traffic volumes, capacity, operating rights, and accidents. | NA | NA |
| International ocean and air travel, international freight flows, transportation facilities, and foreign demographic and economic characteristics affecting demand. | NA | NA |
| NA | Develop a national transportation performance monitoring system | Compile and analyze statistics and publish in the *Transportation Statistics Annual Report.* |
| Develop a uniform commodity coding system. | Improve the comparability of data collected on individual transportation modes to enhance intermodal comparisons and provide an assessment of overall system performance. | Develop guidelines to improve the quality and comparability of DOT's statistics. |
| NA | Integrate and supplement existing data to enhance the capability of DOT to determine the contribution of the transportation system to other national objectives such as economic growth, national security, environmental quality, and energy use. | Economic productivity and collateral damage on the human and natural environment are among the topics required for BTS's *Transportation Statistics Annual Report.* |

Table 5-2.
**The Demands for Statistical Programs and the ISTEA Response *(continued)***

| **U.S. Department of Transportation, *Transportation Information: A Report to the Committee on Appropriations, U.S. House of Representatives, from the Secretary of Transportation,* May 1969** | **Transportation Research Board, *Data for Decisions: Requirements for National Transportation Policy Making,* Special Report 234, National Research Council, 1991** | **Intermodal Surface Transportation Efficiency Act of 1991** |
|---|---|---|
| NA | NA | Represent transportation interests in the statistical community. |
| Develop data integration, analysis, and dissemination media, software, and hardware. | NA | Make data accessible. |
| NA | Explore opportunities for using data that are gathered by the private sector, or collaborate with the private sector in data collection. | Identify data needs. |
| Research new methods of data collection with a particular emphasis on reduction of respondent burden. | Explore advances in data-gathering and information-processing technologies that have the potential to reduce costs and reporting burdens while improving the speed and reliability of data collection and analysis (e.g., automated surveying methods, electronic linking of records through electronic data interchange, automated vehicle and traffic monitoring through intelligent transportation systems technologies, and integration of data into geographic information systems for analysis). | NA |
| Develop geo-coding systems, working with the Census Bureau in urban areas and expanding to rural areas. | NA | NA |
| Establish best methods for passenger travel and urban goods data-collection efforts by local agencies and find ways to ensure use of the methods. | NA | Work with states and metropolitan planning organizations to create an intermodal transportation database. |
| Develop forecasting and explanatory models. | NA | NA |

KEY: NA = not addressed.

Box 5-1.

## BTS Responses to the ISTEA Mandate

The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 outlines five core elements of the Bureau of Transportation Statistics's (BTS's) mission.

**1. BTS is mandated to compile, analyze, and publish a comprehensive set of statistics on the following topics specified in 49 USC 111(c)(1):**

■ ***Productivity of the transportation sector.*** BTS work on productivity measurement with the Bureau of Labor Statistics was highlighted in the 1995 *Transportation Statistics Annual Report* (TSAR). BTS is extending this work through joint research with the Bureau of Economic Analysis (BEA), and aims to provide a broader picture of transportation performance by establishing Transportation Satellite Accounts. These accounts will more accurately measure transportation's contributions to the economy by for-hire and private service providers, equipment manufacturing and related services, and facility construction.

■ ***Traffic flows.*** Previous TSARs summarized mode-specific flows. To enhance this information, BTS initiated the Commodity Flow Survey (CFS) and the American Travel Survey (ATS), which measure multimodal flows. BTS is also developing programs to measure the significant and growing flows of international trade and visitors through the U.S. domestic transportation system.

■ ***Travel times.*** BTS work in this area has focused on air travel for all trip purposes and on journey-to-work by all modes, reflecting availability of data. Increasing interest of decisionmakers on system performance will require a greater emphasis on time and cost aspects of transportation, which in turn will require additional data collection.

■ ***Vehicle weights.*** TSAR 1996 included an analysis of trends from the Truck Inventory and Use Survey (TIUS). Additional analyses will be conducted in the future based on integration of results from the TIUS and the CFS.

■ ***Variables influencing travel behavior, including mode choice.*** Basic trends have been highlighted in the TSAR, and will be explored in greater detail as data become available from the ATS and the 1995 Nationwide Personal Transportation Survey. BTS-sponsored research on the consequences of the Northridge earthquake also provided insights on urban travel behavior. BTS published the Census Transportation Planning Package on CD-ROM, making the largest national database on journey-to-work available to the entire transportation planning and travel behavior research community.

■ ***Travel costs.*** The Consumer Expenditures Survey has been analyzed to measure average costs to households, and results have been reported in the TSAR. Additional work on passenger travel costs needs to be done once data are available from the ATS and can be combined with data from other sources. On the freight side, aggregate estimates are being made from a joint program with the BEA for determining the role of transportation in the economy. Extensive new data collection will be required to obtain shipper costs that are comparable across all modes.

■ ***Availability and use of mass transit.*** Transit statistics are summarized in each TSAR and accompanying editions of *National Transportation Statistics* (NTS). A more detailed analysis is included in chapter 1 of this report.

■ ***Frequency of repairs and service disruptions.*** Comparable data across all forms of transportation do not currently exist. Statistics compiled in the NTS show vehicle age, equipment, service availability, and reasons for delay in modes with available data. Reliability measures are a key element of system performance, and must be designed from the ground up.

■ ***Accidents.*** BTS publishes data from the National Highway Traffic Safety Administration on CD-ROM, and combines that data with other modes in the safety chapter of each TSAR and related sections of the annual NTS.

■ ***Collateral damage to the human and natural environments.*** This topic was featured in the 1996 TSAR, which lists a number of specific data needs. Environmental and energy trends are discussed in each TSAR and data are presented in related sections of the NTS.

■ ***System condition.*** BTS summarizes information developed by the modal administrations in each TSAR and NTS.

**2. BTS is mandated to implement a long-term, intermodal, intergovernmental data-collection program.**

Title 5 of the ISTEA requires BTS to develop an intermodal transportation database on commodity and passenger flows, and public and private investment in intermodal transportation facilities and services. The CFS and the ATS are direct responses to this mandate. Future initiatives include surveys of the domestic transportation portion of international trade and travel, and surveys of costs to shippers and travelers associated with domestic transportation activity. BTS compiles location and connectivity data on intermodal facilities and services for all

Box 5-1.
**BTS Responses to the ISTEA Mandate *(continued)***

forms of transportation as part of its National Transportation Atlas Database (NTAD).

These efforts are primarily federal. BTS is beginning to work with states and metropolitan planning organizations to encourage local data collection that can be integrated with national statistics. Federal-state-local cooperation for data collection is particularly emphasized in the NTAD project, which is part of the National Spatial Data Infrastructure under Executive Order 12906, Coordination of Geographic Data Acquisition and Access.

**3. BTS is mandated to issue guidelines for the collection of information by the Department of Transportation (DOT) to ensure that information is accurate, reliable, and relevant.**

BTS participates in a variety of standard-setting activities, representing DOT on committees that establish or revise the Standard Industrial Classification system, the Standard Occupational Classification system, the Standard Classification of Transportable Goods, the Standard Land Use Coding Manual, and ground transportation elements of geographic data under the National Spatial Data Infrastructure. BTS is represented in departmentwide efforts to measure safety, and successfully established a standard definition of fatal accidents across all modes.

BTS also reviews survey designs for data collection that must be submitted by DOT to the Office of Management and Budget for approval under the Paperwork Reduction Act.

Appropriate and effective methods of coordination for BTS are being studied by the Committee on National Statistics of the National Academy of Sciences as required by Section 6008 of the ISTEA, with a report due in 1997.

**4. BTS is mandated to make information accessible to users.**

BTS is widely recognized for its successes in making information from throughout DOT and from other government agencies accessible to the transportation community through publication of directories of data sources and telephone contact lists, release of data products and data access software on CD-ROM, and an award-winning Internet site. The Bureau's decision not to charge for data and interpretive products developed with ISTEA funds was based on a philosophy of removing all barriers to information.

The challenge ahead is to provide effective technical assistance in the use of data. Microcomputers and CD-ROM technology have made dissemination of and access to very complex databases possible by a wide range of users. The transportation community needs help in understanding how to use the data (e.g., the TIUS characterizes vehicle weights in several ways; BTS can help users decide which of the given applications is appropriate for them).

**5. BTS is mandated to identify information needs.**

BTS continually monitors customer reactions to BTS products and holds outreach meetings with allied organizations to better understand the community's information needs. BTS also established the Advisory Council on Transportation Statistics as mandated under Section 6007 of the ISTEA for this and other purposes.

donments, safety concerns, and proposals to invest in railroad capacity improvements and intermodal facilities.

*Transportation, economic development, and land use.* Data on economic and land-use impacts of transportation are required to understand the relationship between public policy and the ability of transportation to serve businesses and the public. The skeletal and circulatory functions provided by the transportation system are powerful influences on economic activity, encouraging development in some places while discouraging development in others. With development comes economic opportunity and environmental concerns, which vary significantly across regions. Understanding the interactions among transportation, economic development, and land use is central to appreciating the long-term consequences of infrastructure investment. Yet, the regional economic database to support this understanding has been diminished by budget cuts at the Bureau of Economic Analysis. In addition, a consistent scheme for classifying land uses by type of economic activity within devel-

oped areas and a vehicle to collect land-use data on a national scale needs to be developed.

## Evolving Information Needs

Throughout this report, there is discussion of how various aspects of transportation have changed over time. In freight transportation, public agencies and private businesses must be able to respond quickly to rapidly shifting needs. In passenger transportation, a greater number of people are traveling more frequently to increasingly dispersed destinations. The demand for transportation is rising: faster, cheaper, and more reliable service is expected rather than desired. Forecasts of volume and capacity are no longer enough; statistics on cost, time, and reliability are also in demand.

Transportation policy is also changing quickly. Fiscal, environmental, and other concerns are limiting opportunities to build new transportation systems and major public facilities. Economic regulation of transportation service providers has largely been eliminated at the federal and state levels of government, while safety regulation in many instances has become more extensive. With encouragement from the ISTEA, the number of players in transportation policy continues to increase. There has been significant growth in the number of metropolitan planning organizations (MPOs), private sector interests, and citizen organizations now at the table once dominated by federal and state agencies. All are demanding data and the tools to use the data.

Although the number of players and instruments of policy have changed, many fundamental questions remain the same. How can growth in the demand for transportation be accommodated? Are users paying their fair share of public investments? Can transportation's negative effects on safety and the environment be reduced further? Can the needs of transportation-disadvantaged groups be met? What are the opportunities for new technology?

Decentralization of decisionmaking, first from the public sector to the private sector through deregulation, and second from the federal government to state and local governments, is the biggest potential change in the world of transportation policy to be informed by transportation statistics. Completion of the Interstate Highway System, ISTEA mandates, and other forces have shifted considerable decisionmaking to states and MPOs, and have encouraged greater public participation in those decisions. Some proposals call for a more dramatic reduction of federal involvement.

Although such changes would reduce the federal role in financing, regulating, and operating transportation facilities and activities, the need for publicly available transportation statistics would be likely to grow. According to the axioms of economics, the free flow of information is a prerequisite to properly functioning private markets. In the public sector, state and local officials would need to relate conditions in their states and localities to national trends and interstate commerce. After 1977, when the federal government temporarily stopped providing such data, state and local governments and the private sector began to ask for restoration of a federal presence in transportation statistics, leading to the ISTEA mandate for BTS and its programs.

A mandated transportation policy change to be informed through statistics is explicit accountability. The GPRA requires that all federal agencies begin to measure their outcomes, and not just their inputs (typically money) and outputs (typically contracts, grants, and permits). In effect, agencies are being asked to explain whether their actions have had a beneficial impact. The GPRA will be the basis of budget decisions by the Office of Management and Budget and will be monitored by Congress.

The GPRA's focus on outcomes forces many agencies to become aware of the conditions

being measured by BTS and other statistical agencies (see box 5-2). Performance measurement is not just a federal preoccupation: most state departments of transportation and some local agencies are undertaking similar activities. Several states have expressed interest in sharing experiences with performance measurement, but all have been opposed to involvement by federal funding or regulatory agencies in defining and applying state performance measures.

## ► Evolving Sources of Information

DOT obtains information from four basic sources: surveys and censuses, reports from service providers, reports from government agencies, and byproducts of management and control systems. Surveys and censuses are often expensive, obtrusive, and the least timely way to collect data, but may be the only means available in some cases. For example, few people keep consistent records of their household travel unless they are participating in a survey. Reports from service providers, such as filings by carriers for regulatory purposes, also can be burdensome, because the cost of data collection is shifted from the data-collection agency to the respondent. The least obtrusive source of data is byproducts of management and control systems, such as counting vehicles on a turnpike based on toll collections.

Box 5-2.
**Performance Measures: Data Issues**

Performance measures in transportation are typically composites of variables based on direct observation (such as traffic counts and lane-miles) and on estimates (such as vehicle-miles traveled). For a performance measure to be effective:

- the observations underlying the variables must be accurate, reliable, and have adequate coverage;
- the estimation methods must be demonstrably unbiased; and
- the composite measure must be relevant, transparent, and devoid of spurious accuracy.

Many performance measures in transportation fail the relevancy test, either because the measure is not readily linked to real-world experience or because the measure does not capture the desired concept. The commonly used measure of ton-miles illustrates the former; few decisionmakers can readily visualize a ton-mile and relate it to an understood quantity. The ratio of the "transportation bill" to gross domestic product as a measure of transportation's share of the economy illustrates the latter; the numerator and the denominator are based on entirely different forms of accounting and should not be combined.

Whether applied to program administration or general decisionmaking by executive agencies and legislative bodies, performance measurement should respond to the basic questions:

- Are things getting better or worse?
- What is meant by better or worse?
- What is contributing to the improvement or decline?
- What can be done to maintain or improve conditions?

To answer these questions, performance measures must translate inputs and outputs into outcomes.The focus on outcomes is a fundamental shift from traditional measurement activity by public agencies. Programs and program managers have been graded most typically on measures of inputs (e.g., how much money was spent and how quickly were regulations promulgated). Programs and program managers are sometimes graded on output measures (e.g., how many vehicles were purchased or how much highway was repaved). Neither input nor output measures are sufficient to determine whether the shippers and the traveling public have been served effectively and efficiently. Outcomes such as a change in congestion or air pollution must be measured to determine whether an investment, regulation, or service has made a difference and should be maintained or changed.

As information technologies advance, unobtrusive measurement is improving in both sophistication and coverage. (Chapter 11 discusses in-depth the role of information technologies in transportation.) Airline flights are tracked through the skies, trains are dispatched from central traffic control centers, trucks are weighed without stopping, and courier services tell customers where their parcels are at each step of the intermodal movement.

When monitoring and control systems can be tapped, the quantity and quality of data increase dramatically while costs and burden to the respondent plummet. For example, every ticket collected by the airlines is processed through a clearinghouse to allocate revenues when the ticketed travel is not completed on the originating airline. The clearinghouse is a superior source of commercial passenger air travel geography and data on price: BTS is working with industry to tap the clearinghouse as a replacement for the current data-collection system.[1] If the clearinghouse could be used, the burden on the carrier disappears because data collection is fully automated, and errors from sampling or changes in itineraries disappear because 100 percent of the travel is measured directly, and only after the travel is completed.

Switching to unobtrusive forms of data collection is not a panacea. Set-up costs, both fiscal and institutional, can be high, and the nature of data being collected may change, as illustrated by truck data. Formerly, much of this data was obtained for highway planning purposes by stopping trucks at temporary roadside stations and weighing the trucks with portable scales. The operating expenses of temporary weigh stations and the time burden placed on drivers limited the number of observations that could be made and encouraged some drivers to avoid the scales and compromise the representativeness of the data. By switching to weigh-in-motion sensors in the pavement, costs of data collection fell, the number of observations increased by orders of magnitude, truckers were no longer inconvenienced, and bias from scale avoidance was eliminated. The only information obtained, however, was the weight and spacing of each axle. In the past, the driver could be asked about the load, trip origin and destination, and other characteristics. This additional information must now be obtained through surveys or other intrusive data-collection strategies.

A fully developed vision for intelligent transportation systems (ITS) offers the potential to replace most surveys and carrier reports in the future, particularly if traffic control, shipment management, and other systems can be integrated. All of the information obtained in roadside interviews of truck drivers, plus other freight information, could be captured from monitoring systems used by public agencies to manage congestion and collect user fees, and from monitoring systems of carriers to track their vehicles, shipments, and drivers for the company's own logistics, marketing, and safety purposes (see chapter 9, box 9-3).

Such a fully developed vision of ITS has not yet been pursued for two reasons. First, most systems are being designed with an overriding concern for managing day-to-day or minute-to-minute conditions, which in itself is a challenge. Additional requirements for integration and archiving of data are often secondary, especially if integration must be across organizations. (Airlines have developed some remarkably integrated systems within their individual companies, using real-time and time-series data to coordinate everything from ticket revenue yield maxi-

[1] The BTS Office of Airline Information currently collects the data by sampling every 10th airline ticket sold. Airlines submit computerized ticket images or special data files. The results can be distorted by sampling error and by changes in passenger itineraries after buying the ticket.

mization to meal selection to fuel allocation for individual flights.) A much greater problem is concern about proprietary, privacy, and legal issues. Private companies are reluctant to share information with their competitors. Individuals are concerned that personal information provided to a government agency may be available to others. Public agencies are worried that data could be used against them in court; for example, observation of an unsafe condition obtained by an agency before a crash could possibly be used by a victim to sue later for failure to correct the problem.

For these and other reasons, enormous amounts of data are being generated, but not saved. The transportation community must continue to depend on the more costly, more burdensome, and lower quality sources of information until the technological and institutional issues can be resolved.

Improvements are possible in the traditional, obtrusive forms of data collection. The use of computers in telephone and personal interviews can reduce costs and respondent burden by speeding up the interview, improve data quality by providing immediate feedback for unlikely answers, and improve timeliness by automating the compilation of field data. The Census Bureau is experimenting extensively with computer-aided interviewing, and the Federal Highway Administration has sponsored research on the use of inexpensive, handheld computers for data collection.

Such improvements are essential given budget constraints and increasing resistance by respondents to answer traditional surveys. Most statistical agencies' budgets for data collection are being reduced significantly, potentially undermining key data sources for the transportation community. The Energy Information Administration eliminated its Residential Transportation Energy Conservation Survey, the Bureau of Economic Analysis curtailed its regional economic analysis program, and the Census Bureau is under pressure to eliminate or find sponsors for large parts of the quinquennial census. The Census Bureau is also under pressure to find sponsors for the journey-to-work questions on the year 2000 census, which alone would cost far more than the rest of the annual federal budget for major statistical programs related to transportation.

## Evolving Uses and Dissemination of Information

Information technologies affect more than data collection. Rapidly evolving computational power, data-integration methods, analytical tools, and dissemination technology are improving the ability to address policy and other questions, which in turn changes the demand for information.

Sophisticated models, complex analysis, and large data sets are no longer restricted to the largest public agencies and private firms. Microcomputers and CD-ROMs allow the smallest MPO, small motor carriers, local citizen's groups, and individual consultants to manipulate data sets that required multimillion dollar mainframe computers just two decades ago.

Much of the requisite data analysis and integration can be accomplished with off-the-shelf spreadsheet, database, and project management software packages. The major statistical packages and some travel demand forecasting programs have been transferred from mainframes to microcomputers. The development of GIS packages to integrate geographic data and provide a platform for analysis and modeling has especially large potential for transportation analysts. The full potential of GIS is not realized because most of these packages are designed primarily to manipulate area data (in which roads and railroads are just boundaries) rather than network

data (in which roads and railroads are the major objects of interest), and do not handle transportation problems adequately as a consequence. Also, most GIS packages require extensive training to use, and will not enter the mainstream until they are as easy to use as spreadsheets.

The shift of transportation analysis to microcomputers results in two problems, however. First, traditional methods are frequently applied inappropriately to new issues and data. For example, it is now relatively easy to apply the classic four-step urban travel demand forecasting process to estimating local, statewide, or national commodity movements. This straightforward application may result in misleading estimates, because shippers and carriers respond to very different forces in freight transportation than do households and individuals in passenger travel. New models are needed to make effective use of the data now available from the Commodity Flow Survey and local data-collection activities.

The second problem stems from the ease in which users can obtain and manipulate sophisticated data sets without understanding the basis of the data. In the world of mainframe computers and nine-track tape, analysts had to understand the structure of the data before they wrote the program to use the data. Now the analyst can load and tabulate large data sets from CD-ROMs with off-the-shelf database packages without looking at the documentation, creating results that look good but may be entirely wrong. For example, vehicle weight is characterized several different ways in the Truck Inventory and Use Survey. The appropriate measure depends on the application. Novice users might use the first weight variable they encounter—which may or may not be appropriate—when accessing the data with its built-in tabulation software on the BTS CD-ROM *Transportation Data Sampler Number 3*.

These problems create a significant challenge for BTS and other data providers to accelerate research on alternative forms of modeling and analysis, and to place significant emphasis on training. The training challenge is particularly daunting, because customers are no longer limited to a few large agencies.

The growth in analytical capabilities is fueled—and perhaps exceeded—by the revolution in data delivery technology. BTS was fortunate to begin operations just as CD-ROM technology was becoming popular. Each CD-ROM contains up to 630 million numbers or letters and costs less than $1 to reproduce. The next generation disc, based on digital video disc technology, will hold four to eight times as much data, and should be commercially available in 1997.

BTS's Internet site has become an ever more important means of data dissemination and communication with BTS customers. Internet's potential is illustrated by the National Transportation Library, described in box 5-3.

The new technologies of data dissemination and use have reduced the cost of delivering data and tools to each customer, but have resulted in the explosive growth in the number of customers and the demands they place on BTS for service. Many customers are looking for more than data files and format statements: they are demanding help in analyzing and interpreting the data. The Bureau is seeking ways to support wider audiences with technical assistance and analysis in addition to the traditional niche markets of experienced data users served by older DOT agencies.

## Evolution of Transportation Organizations

Transportation organizations in both the public and private sectors must adapt to rapidly changing environments. Flexible manufacturing, cus-

Box 5-3.
**The National Transportation Library**

Libraries are a major component of knowledge bases for most professions. They provide archives for data and reports, and serve as platforms for disseminating information throughout the field. The importance of libraries is underscored by the budgets of the National Library of Medicine (at $152 million per year, estimated for fiscal year 1997) and the National Agricultural Library (at $18 million per year, estimated for fiscal year 1997). By contrast, the national library function has received far less support in transportation, about $3 million in fiscal year 1997.

Historic collections of transportation material are deteriorating with age and neglect. The Department of Transportation (DOT) library, once a national asset for the entire transportation community, is now a limited, in-house service for the Department after two decades of inadequate support. The Association of American Railroads gave away much of its collection in recent years because it duplicated the holdings of the Interstate Commerce Commission. The Commission's library became orphaned by the agency's sunset, and neither DOT nor the Library of Congress had the resources needed to identify and keep materials worth saving. (While the worthwhile historic documents can then be digitized for electronic storage and dissemination, the originals should still be preserved as today's standards for quality digitization will be increased inevitably by better technology in the future.) Instead, the Commission's collection was sent to a warehouse in Denver.

State DOTs, universities, and others are looking at ways to increase the effectiveness and reduce the costs of sharing material. For example, the Minnesota DOT has an excellent library collection, but must use interlibrary loans to fulfill 30 percent of its customer's requests for material. Although many librarians recognize that Internet, CD-ROMs, and related technology offer cost-effective ways to meet the growing demand for information, no one has asserted leadership to develop and implement the technology throughout the transportation community.

Recognizing the importance of dissemination, the Bureau of Transportation Statistics (BTS) established an electronic National Transportation Library (NTL) as a major component of the Bureau's Internet site. The NTL contains electronic documents and other information provided by the transportation community. Most of the current collection comes from state agencies, metropolitan planning organizations, and universities.

The NTL performs two functions: it is a place where DOT can compile and disseminate its own reports; and it is a shared resource available to all members of the transportation community. For example, local planners or their consultants can browse the NTL, see what colleagues in similar places have done to design local travel surveys, and then make copies of the material they want to adapt for their own use. If the user has a question or comment, the NTL provides electronic mail addresses for individuals at all levels of government and in the private sector who have volunteered to help.

Congress recognized the value of the library function when it directed BTS to establish a collection of material on high-speed rail transportation as part of the NTL. BTS is working with the Special Libraries Association and others to improve the content and organization of the electronic collection, and to consider options for establishing an effective archive of printed material (especially maps and other illustrations). BTS is also working with the Secretary of Transportation to resurrect a requirement that all DOT reports be provided to the Department's library so that users do not have to search the 10 operating administrations to find valuable information.

tomer responsiveness, and accountability all require extensive and timely information.

Decisionmaking is increasingly decentralized. Many activities of the federal government have shifted to state and local governments or to the private sector. Within many public and private organizations, decisionmaking authority is shifting from central offices to the "front lines."

Decentralized decisionmaking does not lessen the core activity of DOT: to identify transportation needs and problems and to advocate solutions. This function remains no matter how many investment, regulatory, or other programs are devolved to state and local governments or the private sector. BTS supports this core activity by:

- making Congress and the public aware of the nation's transportation resources, the interaction of transportation with society and the economy, and the consequences of transportation systems; and
- providing information and analytical tools to support public and private decisionmaking.

In effect, BTS provides feedback for DOT and the transportation community on how well the system is serving the nation. This function will be increasingly difficult and more important to perform as traditional sources of information from other federal statistical agencies decline.

## Future Directions

Since the Bureau's formal establishment one year after passage of the ISTEA, BTS has worked within DOT and with other organizations to create a national knowledge base covering all modes of transportation through a range of products and services. In response to customer demands, BTS proposes to build on its initial products and services with three major initiatives. These initiatives are part of the administration's proposal for reauthorization of the surface transportation program.[2]

### Transportation in a Globalized Economy

The initial BTS focus on domestic transportation needs to be expanded to reflect the increasing importance of international trade to the economic health of the nation and its individual communities. This expansion includes:

- *The domestic side of international trade and travel.* BTS proposes to work with the Customs Service and the Census Bureau to determine where and how international trade and travel passes through the domestic transportation system. Such data are key to understanding the impact of trade policies on the demand for domestic transportation facilities and services, and for identifying regional and local opportunities to compete in world markets. BTS has assessed major shortcomings in existing data on these topics as part of the *Transportation Statistics Annual Reports.*
- *The condition, performance, and use of transportation links to other nations.* BTS proposes to assemble information on transportation facilities and services that link the United States to other nations, paralleling DOT's ongoing efforts to measure the condition, performance, and use of transportation in this country. The requisite work involves acquiring commercial data sources, maintaining data programs that may be lost with institutional change, and data integration.
- *An international transportation database.* BTS proposes to build a database to support understanding of international issues, that provides comparative data to inform domestic policy on the transportation experience of other countries, and that contains basic information on international markets for U.S. economic interests.

### Enhancing Relevance of National Statistics for State, Local, and Private Sector Transportation Decisions

The DOT budget is less than one-quarter of all government spending in transportation, and only 5 percent of spending by the public and private sectors combined. For BTS to enhance the effectiveness of transportation decisions, the Bureau's national programs must be made more relevant to the state, local, and private sectors that are the dominant stakeholders. The Bureau proposes to improve the geographical specificity and timeliness of its data programs through increased sample sizes of data collections, the

[2] Section 6002 of S. 458, the proposed National Economic Crossroads Transportation Efficiency Act of 1997.

development of monthly transportation indicators, and the development of innovative analytical and information-sharing programs.

To improve timeliness and minimize the burden of responding to government requests for information, BTS proposes to develop methods of capturing data from traffic control systems, electronic data interchange systems, and other forms of ITS. BTS recognizes that emerging technology makes instantaneous and unobtrusive measurement of transportation activity possible, but that a number of technical and institutional issues must be resolved first. In particular, ways to archive massive amounts of data in a reasonably accessible form need to be devised. In addition, privacy and confidentiality need to be protected.

BTS proposes to provide technical and financial assistance to organizations that can help enhance the relevance of national transportation statistics for state, local, and private sector decisions. These organizations include state agencies, MPOs, universities, and others who integrate local data collection and analyses among themselves and with national counterparts. The proposed grant program would allow BTS to work with nonfederal professionals as they begin to collect data using ITS technologies, with universities and others as they begin to build repositories of transportation data and information on the Internet, and with the private sector to ensure that DOT provides American businesses competing in the global economy with useful and necessary information when it is needed, in an easily accessible format.

The demand for these activities is underscored by the Bureau's participation in the White House Economic Briefing Room, and by a policy statement passed unanimously by the Board of Directors of the American Association of State Highway and Transportation Officials that states:

> . . . the U.S. Department of Transportation should encourage and support the further development of the Bureau of Transportation Statistics, a continuation of the dialogue between the Bureau and the states, and an exploration of the Bureau's services to the states, including the potential for increased technical assistance.

## Performance Indicators

BTS recognizes that significant work is needed to measure outputs and outcomes of transportation programs as required by the GPRA and similar initiatives by state and local governments. Since performance measurement reflects a new user-focused and output-oriented approach, the concepts, specific measures, and supporting data are in the early stages of development. BTS has been assigned to work with other DOT modal administrations to evaluate the data necessary for performance measurement under the GPRA. BTS has also been asked by states and MPOs to help with the development of performance measures for their own purposes.

BTS proposes to develop a program of research, technical assistance, and data quality enhancement to support performance measurement. Research is needed to update and extend past studies of program evaluation methods to transportation. BTS needs to establish a performance measurements methods clearinghouse and other forms of technical assistance if it is to help states and MPOs develop their own performance measures. Data quality enhancement is needed in several programs sponsored by BTS and other DOT modal administrations to assure the validity and precision of performance measurement.

## Beyond Reauthorization

Whatever specific directions are set by Congress, BTS and the other statistical agencies will continue to evolve. The Bureau focused much of its

early energy on restoring the knowledge base in transportation statistics after a long period of decline, and must maintain that investment in information capital. BTS will also continue to develop the knowledge necessary to deal with emerging transportation technologies, dynamic economic and social forces that alter transportation demand, and the unintended consequences of transportation for safety, energy, and the environment. This knowledge base is essential to guide transportation investments and services that account for 11 percent of gross domestic product, 19 percent of household expenditures, and the physical links that hold the nation together.